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RUBBER PRODUCTION IN CEARÁ, BRAZIL

BY
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ALTHOUGH various commissions of the American government have been investigating rubber sources in the Americas for many years, especially after measures were taken by foreign governments to control rubber production and prices, there still were rubber yielding plants, as late as 1943, which had not been adequately studied. Most of these, to be sure, had been tapped during the rubber boom years, but the rubber buyer often did not know which type of plant yielded a particular grade of rubber, or from what district it had come. In one northeastern Brazilian state alone, Ceará, nine types of trees were being tapped by the end of 1943; in many areas it was impossible to find a rubber producing tree which was not being utilized. However, little was known about the production methods which were being used or whether or not they could be improved upon. Studies of these rubber yielding plants and the methods of extraction and preparation of their rubber had been made earlier (Ule 1908, Zehntner 1914), but these were out of date by 1943.

Investigations carried on during 1943–1945 in Ceará

[1]The data for this paper was gathered during 1943–45 while the author was employed as Field Technician for the Rubber Development Corporation.

by field technicians of the Rubber Development Corporation, a United States government agency, determined the identity of the various rubber sources and disclosed that the local methods of production then in use were so well developed that only slight changes and improvements were necessary to extract the maximum amount of rubber from the available trees.

The various sources of rubber in Ceará and the methods of rubber production will be discussed in detail in this paper.

The surveys showed that in Ceará only two genera were important, *Hancornia* and *Manihot*, occurring wild with the exception of some small plantings of *Manihot* in northern Ceará made during the last rubber boom. A few isolated trees of *Castilla* (*caucho*) and two small colonies of *Hevea* were planted in damp mountains near Baturité, the Hevea seed coming from the territory of Acre. While extremely variable in yield, most of the few Hevea trees are of good quality and are now being tapped by the method used on most Eastern and African plantations (Plate XXXVIII, A) which is by means of a panel carefully cut with a jebong knife (Klippert 1942).

For several months in 1944 smoked sheets of Hevea rubber comprised the larger part of Ceará rubber exports. These were Far Eastern plantation sheets (Plate XXXVIII, B) produced under Japanese control and were being transported in German ships which were sunk near the coast by American planes and boats. Many fishermen earned more money during these months by salvaging the floating rubber than they had ever earned by fishing.

Hancornia

This genus occurs from Paraguay and Bolivia through the states of Mato Groso, São Paulo, Goiaz and Minas Gerais to Ceará, Piauí, Maranhão and Pará in Brazil

(Schery 1942). Although the genus *Hancornia* has been split into many species and varieties, the present tendency is to reduce the number. There are few herbarium specimens, and for this reason the latest review of the genus (Monachino 1944) can only be considered as a preliminary treatment. Most of the material is called *mangabeira* locally and may be classified as *Hancornia speciosa* Gomes. In Ceará (map, figure 1) mangabeira is found in small areas along the sandy coast, on the high sandy *chapada* or wooded savanna of the Serra de Araripe, and in one small isolated colony in the Serra de Ibiapaba near Campo Grande. The trees vary in size from thick-trunked, aged specimens, which resemble old apple trees,

FIGURE 1. Map of the State of Ceará, Brazil, with inset map of South America showing location of the state.
(*Drawn by Gordon W. Dillon*)

to slender saplings which frequently die after the first tapping. Seedlings are absent from most areas because the local custom of burning the chapadas, even though prohibited by law, has exterminated most perennial plants which do not have a protective covering of bark or heavy leaf bases.

Only the poorest and most primitive of the Indian-White mixtures live in the areas which mangabeira prefers. These people are strongly resistant to innovations and, even where it is possible to demonstrate positive superiority of a new method, there must be an inertia-overcoming incentive before the change will even be considered. While this conservatism is characteristic of most people dependent upon the soil, and equally true of American farmers as well as Brazilian agriculturists and woods-people, this conservatism is especially evident in the Ceará coastal mangabeira areas, because most of the tapping is done by women who are even more conservative in their outlook than men. The trees are usually tapped three times each year with deep V-notches cut with a small paring knife. Because the latex flow is of short duration and cups are seldom on the tree for more than half an hour, mangabeira may be tapped throughout the year, in both the rainy and the dry season. For cups, tough and leathery *araticum* leaves (*Annona coriacea* Mart.) are folded into cones (Plate XL, A), pinned with splinters or cactus spines and slipped under a flap cut in the soft bark. If the tree yields well, the shallow cup overflows; if the wind blows, it overturns. Even though the additional latex gathered by using tin cups would pay for all the necessary cups in less than two days, only a small portion of the workers have been induced to adopt them. Yet, even leaf cups are an advance over the method which, though rare in Ceará, is common in Maranhão, a state to the north-

west. In this method, the bark is smoothed with a machete to within 4 mm. of the wood on about a third of the circumference of the trunk to a height of 70 cm. Many pricks and small cuts are made in this panel with the tip of the machete, and the latex which exudes is scraped off with a spoon and collected in a gourd. Many of the trees tapped in this manner are left with huge gaping wounds and cannot be retapped even if they survive.

The best methods of tapping mangabeira are those used in the Serra de Araripe. The workers organized to tap on the high chapada use a special knife with one end bent into a U for cutting the latex groove, the other end sharpened to a point to make an incision cutting all the latex vessels underlying this groove down to the wood. Below this V-cut a tin cup is pushed into the bark to receive the pink latex. Cuts are made at 40 cm. intervals from the ground as high up on the tree as can be reached (Plate XXXVIII, C). Even branches as small as a man's arm may be tapped and some trees support as many as twenty-five cups. When a basal cut is made before dawn, the latex may overflow a 120 cc. cup, yet the same cut made at 10 A.M. would yield only 5 cc.

A few workers in the Serra de Araripe use the same style of two-ended knife to cut a deep spiral groove on the trunk, from the highest point they can reach to the ground. Here a leaf is inserted in the cut to funnel the latex into a bottle. While there have been reports of trees which will fill a 750 cc. bottle by this method, these trees must be extremely rare, for even with cups the most skilled worker seldom secures more than 400 cc. of latex even from the rare large virgin trees. Claims of five to eight liter yields must be received with skepticism. Most trees can be tapped three times in good years, but only once if rains are scarce.

Mangabeira latex usually coagulates very slowly in

comparison with the latex of *Hevea* and manisoba (*Manihot*) which coagulates rapidly when it becomes slightly acid. Two and three months old samples of mangabeira latex may remain liquid even when they are slightly acid. The strength and vulcanization properties of mangabeira rubber are affected by the methods of coagulating the latex and handling the coagulum. It was a difficult task, second only to that of inducing the natives to tap the trees, to introduce acceptable methods for rubber preparation.

The natives have long used the dried strings of rubber found in crude cuts on the tree for making small hard balls and the latex for making waterproof sheets or shoes. In one good native recipe for coating cotton cloth a tablespoon of powdered sulfur and the white of an egg are mixed with a large cup of water, added to a liter of pure latex and spread thinly over the fabric. When dry this is placed in the sun for a day to cure.

The first mangabeira rubber produced for export was made by heating the pure latex in a bowl over a fire, adding a variable amount of salt or alum, if either were available, and removing the mass when it had coagulated. A worker can do this so that all of the original water in the latex remains entrapped in the thick soft coagulum, which then has the same 20 to 33 per cent rubber content of the original latex. The most practical method of preparing the rubber in Ceará is to add an equal amount of warm water to the latex and then a small amount of a solution of table salt. Coagulation takes place within half an hour. Locally made clay or wood basins are more satisfactory for coagulation trays than the usual kerosene cans, for the tannic acid in the latex does not then encounter rust and consequently the blue-black ink caused by the rust combining with the tannin does not stain the rubber.

The coagulum, about 3 cm. thick, is placed on a board and rolled by hand to a sheet about 6 mm. thick, then washed in a basin with water and hung in the shade to dry. Home made rolling machines which resemble wringers with wooden rollers are used in many places to produce sheets of uniform thickness. To corrugate or to smoke the sheets is inadvisable in Ceará because prepared mangabeira rubber deteriorates rapidly, especially when nearly dry and exposed to the air.

There are better methods for the preparation of mangabeira rubber, yet none is as satisfactory for field use. By the use of exact quantities of expensive chemicals and careful heating it is possible to produce a mangabeira rubber which approaches Hevea in quality. However, the native tappers lack the skill and the careful habits necessary to accomplish this, and it was even difficult to introduce the simple scheme outlined above.

Manihot

Manihot is a large genus with its center of distribution from Ceará to central Baia, Brazil. It is best known to Americans in the form of tapioca which is obtained from *Manihot esculenta* Crantz, a species native to Brazil, and like *Hevea*, extensively grown in the East Indies. As in the genus *Hancornia* many species have been described, but the paucity of specimens in herbaria, the scanty material upon which many species were based, and the difficulties encountered in the field in ascribing many of the variable trees to a definite species suggest that a monograph of the genus based upon field study in this part of Brazil is needed.

Manihot Glaziovii Muell.-Arg., the large rubber yielding species which has been tried on plantations in Africa and the East but replaced by *Hevea*, is native to the Serras of Baturité and Maranguape, Ceará. Most of the

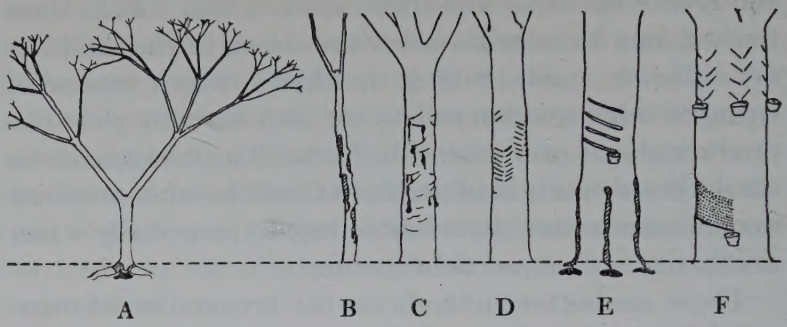

FIGURE 2. Manisoba (*Manihot*) tree types and tapping methods in Ceará.

A. Piauí manisoba, tapped on the root with latex gathered in a dust-lined hole in the ground.

B. Serra de Uruburetama manisoba with hand-sized pieces of bark removed down to the wood. The latex dries and coagulates upon the bark and exposed wood surface in strings and globules called *choro*.

C. Low-yielding manisoba typical of region west of the Serra de Maranguape and of that about Sobral, Pereiro and Assaré. The trunk is hacked irregularly and the latex strings dry and coagulate upon the bark.

D. *Brava* manisoba which yields practically no latex, but has been hacked experimentally to see if it will yield.

E. Manisoba of the Serra do Machado, west of Canindé. Below, it has been tapped on the saliences of the trunk and the latex collected in dust-lined holes in the ground; above, it has been tapped experimentally with an Amazonas knife, a method which proved unsatisfactory for general use.

F. Manisoba of the Serras de Baturité and Maranguape. Above, it is tapped with the daily paired upward cuts and the latex flows into the tin cups; below, a panel cut with the jebong knife, a method which is excellent only if the tappers are careful and conscientious.

trees are tapped by two upward cuts with a short machete or a narrow-bladed hatchet (Figure 2 F). A tin cup is slipped under a slit in the bark directly below the vertex of the cuts (Plate XLI, A). The tapper begins each Monday inserting one to eight cups about the circumference of each tree. On Tuesday he taps about six inches below the previous cuts and affixes the same cup with its now coagulated rubber into a slit below the second tapping. This is continued until Saturday when the lumps of rubber coagulated during the week are collected and spread out to dry (Plate XLI, B). These lumps are often cut into smaller pieces to speed drying or are sold at a low price (while still fresh) to a merchant who dries the rubber to secure a higher price. Even though the latex flow increases when the rains begin, tapping is discontinued, partly because cups frequently fill with rain water before the latex coagulates, but mainly because farming is done at this time.

In the damp mountains of Baturité and Maranguape where the latex flow is greater, *Manihot Glaziovii* may be tapped by cutting with a jebong knife in a manner (Figure 2 F) similar to that used for *Hevea*. A sharp knife must be used and care taken to avoid injuring the cambium. This method was introduced on two small properties and in both cases the yield was greater per man-day, much greater per unit of trees, and, when some care was used in tapping, the trees were scarcely damaged. The method was abandoned after a few weeks, however, for the workers did not sharpen their knives and would not use care to avoid cutting the cambium, nor would they utilize the bark to greatest advantage. The narrow-bladed hatchet which is used to prune coffee trees in the mountains cuts a very small gash deep into the wood and severs only a few latex vessels in the bark. The short machete used on the mountain slopes and

plains barely cuts to the wood, but opens more latex vessels. By substituting the machete for the hatchet or inducing the producers to use wider-bladed hatchets, it was possible to decrease the damage to the trees, preserve a bark surface satisfactory for retapping, and at the same time increase the yield of rubber with no extra labor. A modified Amazonas knife to cut a deep groove was unsatisfactory because cuts which were too close together left the bark between them dry and dying, a ready shelter for termites.

In the same area, the Serras of Maranguape and Baturité, a type of manisoba tree occurs which yields practically no latex. This is called *manisoba brava*, wild manisoba (Figure 2 D). There is a complete series of intergrades between the best yielding manisoba and the driest of these wild trees. It is difficult to say whether there are two intergrading species or one variable species. Frequently one can distinguish the extremes by their bark, which is gray and thickened in the rubber-yielder, and reddish or silvery (usually smooth and thin) in the wild type. The natives believe that by hacking them regularly, it is possible to stimulate or "tame" (*amansar*) some of the wild trees so they will produce latex (Plate XLI, C). If the latex does not flow after three or four weeks of this treatment, the trees are abandoned. The basis for this belief in "taming" is a phenomenon known as wound-response. In response to the stimulation of tapping, manisoba and *Hevea* both increase their yield slowly for about three weeks when they reach a maximum at which they remain unless overtapped or injured.

West of the Serra de Maranguape the trees resemble the *brava* type, although in damp places they still yield enough latex for cup-tapping. Trees of the drier places are cut and hacked with the machete so the latex flows over the trunk (Figure 2 C) and coagulates and dries in

strings or globules which are collected two weeks later when the tree is hacked again. This type of rubber is called *choro*, or tears, and resembles the lacy strips left in cuts made by other methods and sold under the name of *sernamby*.

Still farther to the west, about the Serra de Uruburetama, excellent *choro* is produced by slicing the bark off the trunks in hand-sized patches (Plate XLI, D and Figure 2 B). After the cuts are made, the latex is allowed to drip over the trunk and dry for twelve to thirty days before it is collected and a new series of cuts made. Most of these trees are small, spindling, gnarled and scarred, like the legs of undernourished children. There are some larger trees which yield more latex and can be tapped profitably with cups, but practically all of the rubber produced in this area is *choro*. Several unsuccessful experiments were conducted to find practical methods which would yield as much or more latex than the local *choro* method and still not injure the tree. However, the large exposed surfaces of clean wood left by slicing off the bark are less harmful to the trees than the termite infested areas of dried and dead bark about the cuts made by other methods, such as those used in the Serra de Maranguape. In the Serra de Uruburetama the horny outer layer of the manisoba bark made it difficult to use the jebong or Amazonas knife, and the low yields, scattered stands, and rough terrain made it impractical to tap daily.

Even farther west, in hills near Sobral, only poor-yielding trees are found and none of the spindling but good-yielding Serra de Uruburetama trees are seen. *Choro* is produced by both of the methods described: by hacking cuts over the surface of the trunk, or by chipping away chunks of the wood.

About Assaré in southern Ceará and Pereiro in east-

ern Ceará, there are many manisoba trees which, like those near Sobral, greatly resemble *brava* trees (Figure 2 C) and like them yield a resinous, though much more abundant latex. The Assaré and Pereiro trees are hacked severely every two to four weeks. After the dried rubber is collected any part of the trunk which can be reached may be hacked again. Most of the rubber is a dark and sticky *choro*, but some of the cuts yield so much latex that globules an inch or more in diameter are frequently found. These are pressed out to form small plates about 5 mm. thick and 80 mm. long and are sold at a higher price than *choro*. These plates resemble the rubber produced in central Ceará, west of Canindé.

West of Canindé rises a low mountain range, the Serra do Machado, which is poorly represented on maps. In this area there are many trees which yield a small amount of latex. Some of the trees could be classified as *brava*, while still others have a latex flow sufficiently large to make the use of cups possible. Nearly all of the trees are tapped from a point about a meter high to the ground (Plate XL, B and Figure 2 E) by slicing away the bark on the four to eight saliences of the trunk. A small hole is dug in the ground and lined with a thin layer of dry dust (called *tabatinga*, *tauá*, or simply *pó*), which is carefully prepared by pounding up calcareous clay and sieving it. A sack of this dust is as much a part of the equipment of a good rubber gatherer (*borracheiro*) as the small tapping hatchet (Plate XXXIX, B). The latex flows over the surface of the powder which lines the holes and, like raindrops on a dusty road, does not soak in but coagulates into a small plate called *chapa*. These trees are tapped at infrequent and irregular intervals, the successive tappings merely removing a thin layer of the bark on both sides of the original vertical cut, a procedure which, although it cuts away the cambium, has much in

common with the jebong cut panel. The rubber is gathered after a few days and the tree may be tapped again, although a tree is seldom tapped more than six times in one season.

Well prepared *chapa* is a good rubber, because whatever little dirt normally adheres to it can be easily removed before selling. There are several tricks employed by the natives to add weight to the rubber. The most common of these is to turn over the coagulated latex before making a new cut and then to allow the second flow to cover the dirty surface. When this *chapa* is removed it presents two smooth and clean surfaces. A wise buyer soon learns to be suspicious of rubber which is too smooth and clean on both surfaces, so the tappers occasionally leave the first *chapa* in the hole, kick in a small amount of dirt and allow the new latex to flow in and cover the dirt with rubber. This is more difficult to detect unless the piece of rubber is suspiciously large, since one surface is smooth and the other slightly rough. Careful buyers have all the large pieces cut up because this practice not only allows them to calculate the discount which must be made for the dirt, but enables them to dry the rubber faster, sell it at a better price as a grade with higher rubber content, and reduce the freight and taxes which are based on weight.

Many property owners in the Serra do Machado are planting manisoba seeds with other crops. Snr. José Velosa of Sitio Valtiburí has planted 900 kilos, about 810,000 seeds. He plants beans, corn, cotton, mandioca, castor beans and manisoba at the same time in his field, and the harvest is made in this order. At the end of two years only a few plants of castor bean and cotton remain and the mangabeira is ready to be tapped.

Most of the rubber produced in Piauí, the state west of Ceará, is *chapa*. It is collected in a hole dug in the

ground and lined with dust, just as in the Serra do Machado. The tree and the tapping method differ. The tree is scarcely more than a large bush, branched and spreading from a short trunk (Figure 2 A and Plate XL, C). It grows very rapidly and some one year old trees which were planted on fairly good soil in northwestern Pernambuco have been tapped.

In Ceará the only native Piauí type trees are found along the southwestern margin of the state, and there are scarcely any plantings. To tap the tree the roots are exposed, a hole is dug to receive the latex, lined with tabatinga (Plate XL, D), and a groove is cut into the root down to the wood. Every three or four days the coagulated rubber *chapa* is collected and a new cut made below the old one until it is difficult to reach into the hole with the tool. At this time the tree is abandoned for the year and, since the hole is rarely ever refilled, the uncut bark frequently dries and the tree dies.

Well-prepared clean manisoba and mangabeira rubber can be used instead of Hevea in many small rubber industries. To improve low grades like *choro*, which make up the bulk of the Ceará production, washing plants have been established in northeastern Brazil. In washing, crude rubber is passed between two large rollers. These revolve at differing speeds and separate the rubber so that the streams of water which flow over the rollers can remove any dirt. If the washing is done well, the rubber leaves the rollers as a clean sheet of crêpe which needs only to be dried before it can be utilized by the manufacturers. Washing low-grade rubber is difficult and expensive. For this reason, and because of the great diversity and variability of the Ceará rubber and the unpredictable fluctuations in production, it is unlikely that exportation will increase. Ceará rubbers cannot compete in either quality or cost with the Hevea produced on

plantations during the last decade. Industry will continue to prefer the uniform reliability of cleaner and more abundant Hevea.

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PLATE XXXVIII. A. Tapping *Hevea* with the jebong knife on Sitio Irapuru near Baturité, Ceará. This panel has been tapped for an entire season. B. Smoked sheets of oriental Hevea rubber recovered from the sea. C. Tapping *Hancornia* near Axixa, Maranhao. Even the branches are tapped and some trees support as many as twenty-five cups.

PLATE XXXIX. A. Preparing rubber from latex of *Hancornia* near Axixa, Maranhao. B. Serra do Machado workers filling their bags with the fine dust used to line the holes in which the latex is collected.

PLATE XL. A. Native women making a cup from an *araticum* (*? Annona coriacea* Mart.) leaf for gathering the latex, near Cascavel, Ceará. B. Serra do Machado manisoba tree tapped with a small hatchet on the saliences of the trunk. The latex flows into a dust-lined hole. C. One year old planting of Piauí manisoba at Belmonte, Pernambuco, ready for tapping. D. Lining a hole with dust to receive the latex flow, at Belmonte, Pernambuco.

PLATE XLI. A. Inserting a tin cup in a slit below the pair of tapping cuts in a manisoba near Maranguape, Ceará. B. Drying coagulated cup-lumps of manisoba rubber at Maranguape, Ceará. C. Brava, or wild manisoba near Maranguape, Ceará, which has been hacked to see if it will yield latex. D. Manisoba trees in the Serra de Uruburetama near Iraçuba, Ceará.

Plate XXXVIII

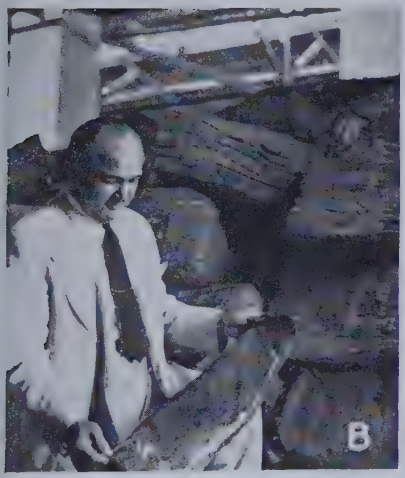

Plate XXXIX

Plate XL

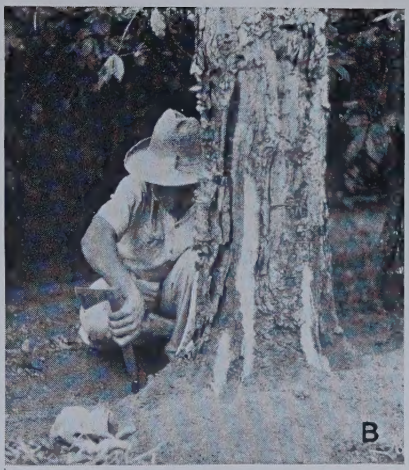

Plate XLI